VIRGINIA STANDARDS OF LEARNING

Spring 2004 Released Test

END OF COURSE
Chemistry

Large Print Form

DIRECTIONS

Read each question carefully and choose the best answer.

SAMPLE

Which of the following is a balanced equation?

A $H_2 + Br_2 \rightarrow 2HBr$

B $H_2 + Br_2 \rightarrow HBr$

C $H_2 + 2Br_2 \rightarrow 2HBr$

D $2H_2 + Br_2 \rightarrow HBr$

GO ON

1 Many reactions are taken to completion by heating the reaction mixture in a test tube. Each of the following would be a safe practice EXCEPT

A heating the test tube gently to prevent the solution from boiling over
B pointing the test tube away from others so that no one is injured
C placing a stopper in the test tube to prevent gas from escaping
D holding the test tube with test tube clamps to avoid touching hot objects

GO ON

2 A student spills a diluted acid solution on his hand. He should

F wipe it off with a paper towel

G let it air dry

H apply a base solution to neutralize it

J rinse it off with running water

3

Trial	Volume	Pressure	Temperature
1	100 mL	250 mm Hg	298 K
2	300 mL	83 mm Hg	298 K
3	500 mL	50 mm Hg	298 K

A student wants to study the effects of volume on gas pressure. During his experiment, he recorded the data in the table. How could he now study the effects of temperature on gas pressure?

A Vary the temperature but keep the gas volume constant

B Vary the volume of the gas only

C Vary the pressure and temperature of the gas

D Vary the temperature and volume of the gas

GO ON

4 A student was instructed to carry out an experiment that illustrates the law of conservation of mass. The teacher indicated that the experiment should be carried out three times. The student plans to report the average of the three results. What can the student do to maximize the reliability of the data collected?

F Report the result that came closest to the class average

G Conduct each trial using the same balance

H Report the average of the two most similar values only

J Perform each of the trials on different days

GO ON

5

Procedure	Initial Volume (m^3)		Final Volume (m^3)		
	N_2	H_2	N_2	H_2	NH_3
A	1000	3000	600	1800	800
B	1000	3000	250	750	1500
C	1000	3000	450	1350	1100
D	1000	3000	375	1125	1250

A chemical engineer for a fertilizer company is determining the most efficient way to produce ammonia. The engineer carries out the Haber reaction under four different conditions. According to these data, which procedure gave the greatest percent yield?

A A

B B

C C

D D

GO ON

6 $$A + B \xrightarrow{\text{catalyst}} AB$$

A student conducted an experiment to study the effects of temperature on this chemical reaction. The student's experimental conditions are shown in the table.

	Trial Number			
	1	2	3	4
Temperature	17°C	18°C	20°C	16°C
Amount of catalyst	1 mg	2 mg	3 mg	4 mg
Amount of A	5g	5g	5g	5g
Amount of B	7g	7g	7g	7g
Time for reaction to complete (min)	10	8	5	3

Which of the following would improve the student's experimental design?

F Use the same amount of catalyst in all trials

G Keep all tubes at 18°C

H Keep the reaction time constant

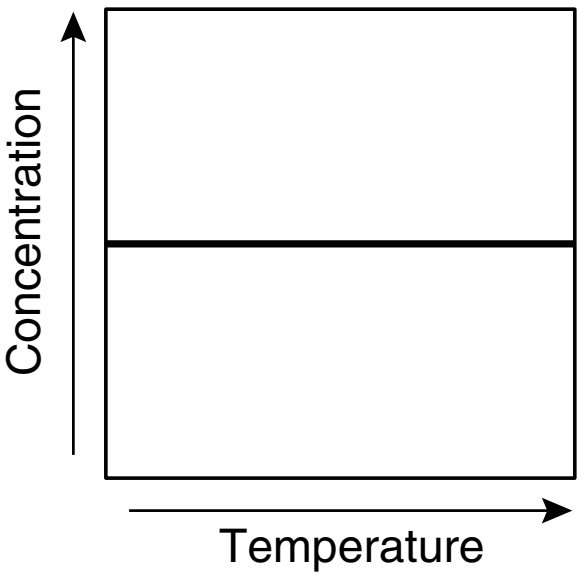
J Decrease the quantity of reactants

GO ON

7 **Generalization: As temperature increases, the solubility of a gas in a liquid usually decreases.**

Which graph best represents this generalization?

A



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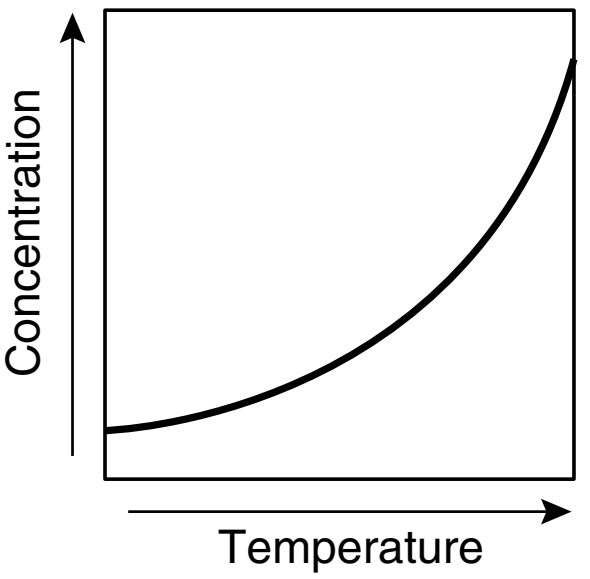

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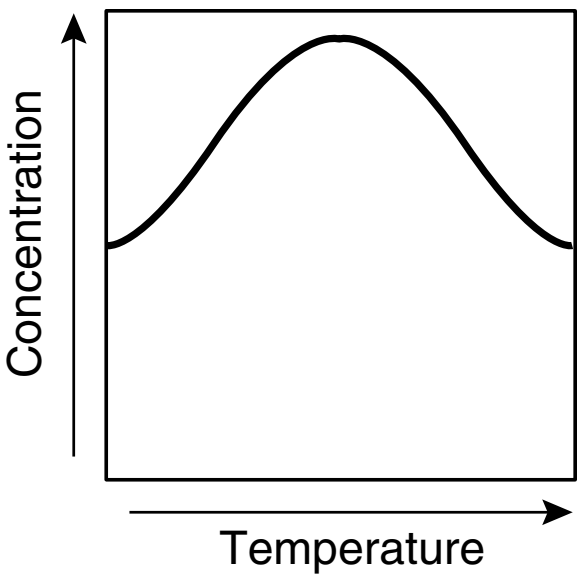

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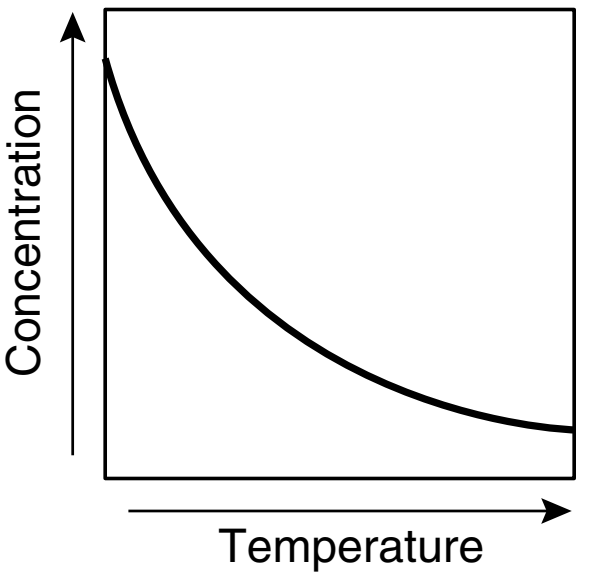


GO ON

8 The mass of an object was recorded as 9.93 g, 9.90 g, and 10.02 g, using an electronic analytical balance. What is the average of these three masses expressed to the correct number of significant figures?

F 9.9 g

G 9.95 g

H 10.0 g

J 10.00 g

9 An increase in atomic number is related to an increase in atomic mass because

A more electrons are present in the atomic nucleus

B more electrons are orbiting the atomic nucleus

C more protons are present in the atomic nucleus

D more protons are orbiting the atomic nucleus

10 Three elements, X, Y, and Z, have consecutive increasing atomic numbers. If element X is a noble gas, what will be the symbol for the ion of element Z in its compounds?

F Z^{2-}

G Z^{-}

H Z^{+}

J Z^{2+}

11 According to their placement on the periodic table, which elements would have the most similar atomic structures?

A Sodium and scandium

B Sodium and barium

C Sodium and potassium

D Sodium and aluminum

GO ON

12

Electronegativity Values of Some Atoms

2.1 H						
1.0 Li	1.5 Be	2.0 B	2.5 C	3.0 N	3.5 O	4.0 F
0.9 Na	1.2 Mg	1.5 Al	1.8 Si	2.1 P	2.5 S	3.0 Cl
0.8 K	1.0 Ca				2.4 Se	2.8 Br

Electronegativity differences are often helpful in determining the bond character between two atoms. A general rule states that if the electronegativity difference between two atoms is greater than 1.67, an ionic bond would most likely be formed. Using the chart above, which pair of atoms would probably form the strongest ionic bond?

F Al-P

G Na-Cl

H K-F

J Ca-O

13 ns^2np^3

Which of these elements is found in a family with the electron configuration?

A Al

B Sr

C Si

D Sb

14 Neils Bohr's contribution to modern atomic theory was the proposition that

F each atom has a specific number of positive charges

G an atom has electrons in discrete energy levels

H electrons have a definite mass that can be computed

J atomic mass is determined by the number of protons and neutrons in an atom

15 O_2, N_2, Cl_2, and I_2 are examples of

A diatomic molecules

B compounds

C ionic compounds

D atoms

16 **Selected Polyatomic Ions**

Name	Formula
Hypochlorite	ClO^-
Chlorite	ClO_2^-
Chlorate	ClO_3^-
Perchlorate	ClO_4^-

Chlorine and bromine are in the same family in the periodic table. According to the information in the table above, what would be the correct formula for sodium bromate?

F $NaBrO$

G Na_2BrO

H Na_3BrO_3

J $NaBrO_3$

17 **Which of the following is a balanced equation?**

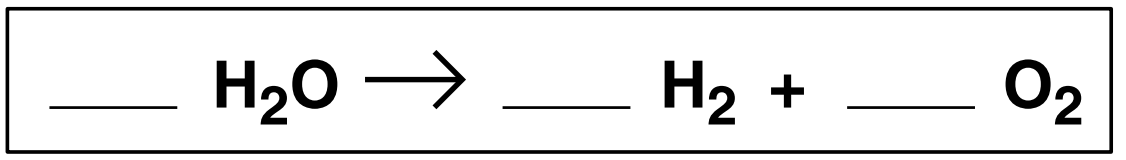
A $C_3H_8(g) + O_2(g) \rightarrow CO_2(g) + H_2O(g)$

B $C_3H_8(g) + O_2(g) \rightarrow 3CO_2(g) + H_2O(g)$

C $C_3H_8(g) + 2O_2(g) \rightarrow 3CO_2(g) + 4H_2O(g)$

D $C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(g)$

18



The coefficients of the correctly balanced equation for the reaction above are

F 1, 1, 1

G 1, 1, 2

H 2, 1, 2

J 2, 2, 1

GO ON

19 Which of the following best represents the reaction between sulfuric acid and calcium hydroxide?

A $H_2SO_4 + Ca(OH)_2 \rightarrow CaSO_4 + H_2O$

B $HSO_4 + CaOH \rightarrow CaSO_4 + H_2O$

C $H_2SO_4 + Ca(OH)_2 \rightarrow CaSO_4 + 2H_2O$

D $H_2SO_4 + 2Ca(OH)_2 \rightarrow 2CaSO_4 + 3H_2O$

20 A compound is composed of 58.8% C, 9.8% H, and 31.4% O, and the molar mass is 102 g/mol. What is the molecular formula for this compound?

F $C_2H_{10}O_3$

G $C_5H_5O_3$

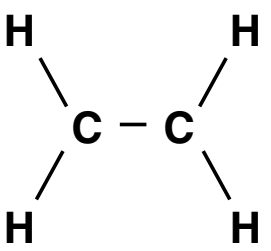
H $C_5H_{10}O_2$

J CH_3O_3

GO ON

21 The correct structural formula for C_2H_4 is

A



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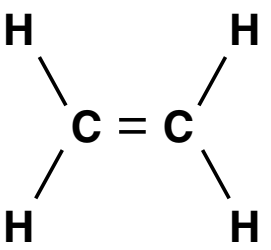

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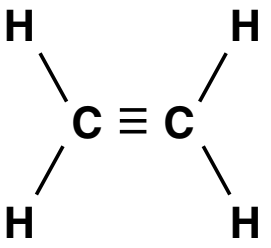


D H – C ≡ C – H

GO ON

22 In chemical compounds, covalent bonds form when

F the electronegativity difference between two atoms is very large

G electrons are completely transferred between two metals

H pairs of electrons are shared between two nonmetal atoms

J two nonmetal ions are attracted to each other by opposite charges

23 Which of the following reactions is a decomposition reaction?

A $S_8 + 8O_2 \rightarrow 8SO_2$

B $O_2 + 2H_2O \rightarrow 2H_2O_2$

C $2KClO_3 \rightarrow 2KCl + 3O_2$

D $2Na + 2AgCl \rightarrow 2NaCl + 2Ag$

GO ON

24

$$Fe + CuCl_2 \rightarrow FeCl_2 + Cu$$

The type of reaction represented by the above equation is

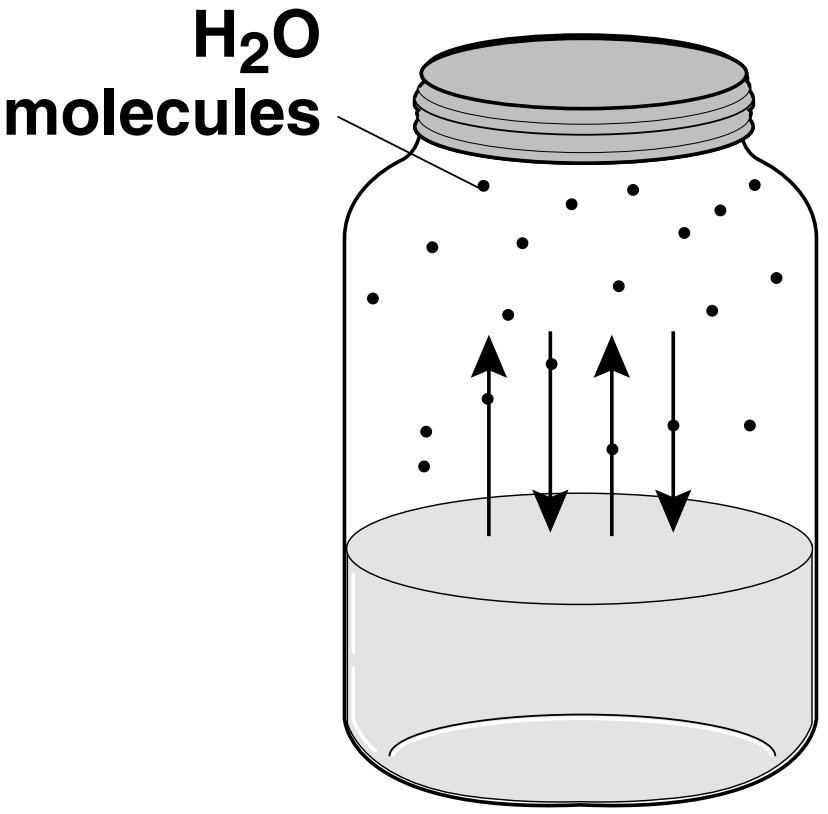
F single replacement

G double replacement

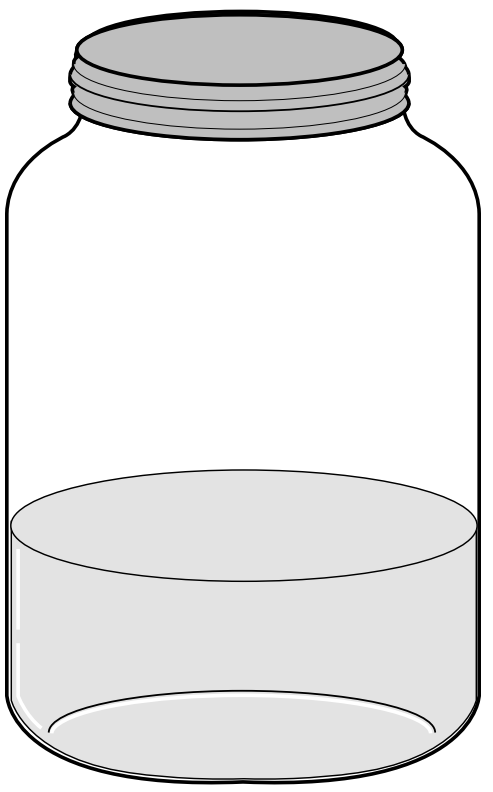
H synthesis

J decomposition

25 Which of the following containers of water BEST shows dynamic equilibrium between vapor and liquid?



A



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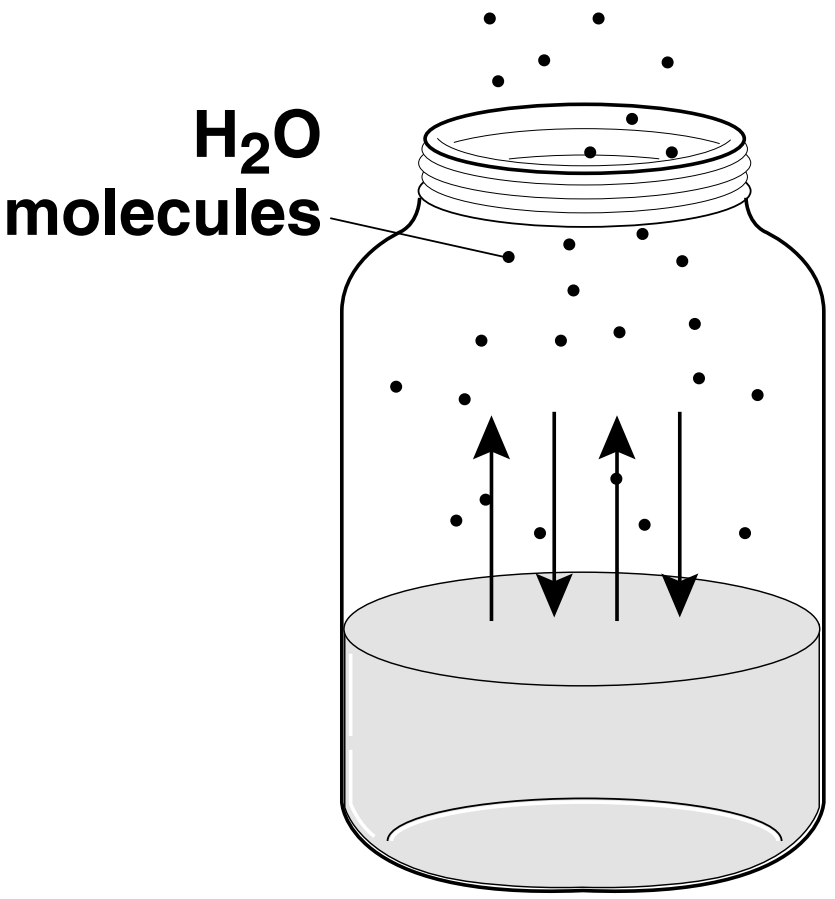

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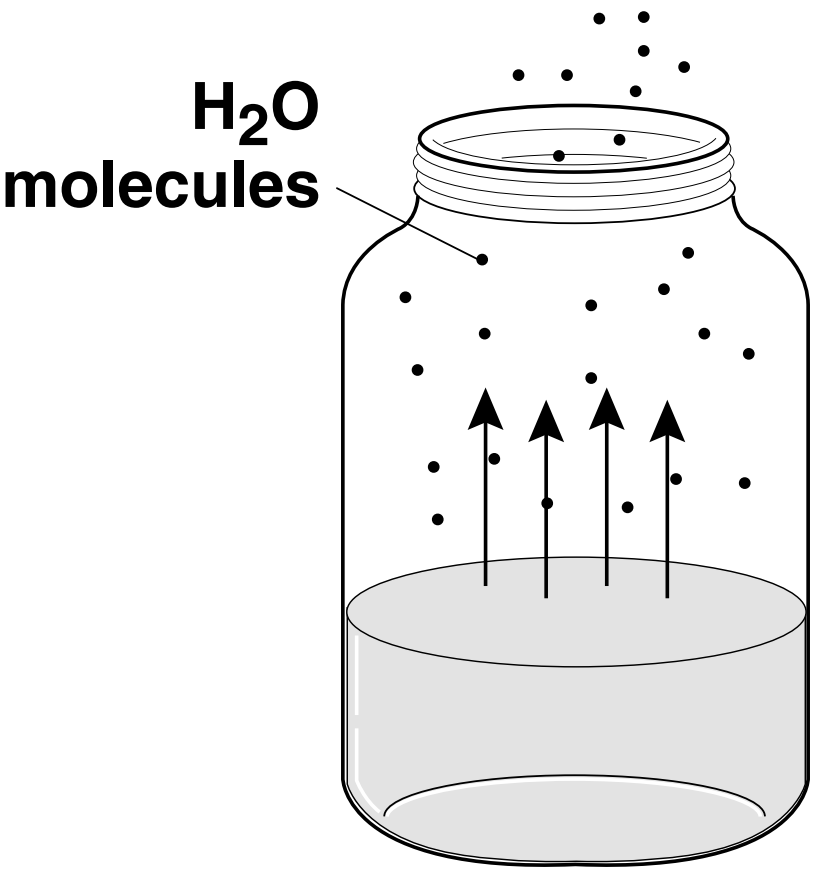


D

GO ON

26

$$Na_2S_2O_3(aq) \xrightarrow{H_2SO_4} Na_2SO_3(aq) + S(s)$$

In the above reaction, a cloudiness at completion due to colloidal suspension of sulfur appears. If the reaction is carried out at various temperatures, at which temperature would it proceed at the fastest rate?

F 20°C

G 30°C

H 40°C

J 50°C

27 **Which of these is about 2 moles?**

A 2.0 liters (dm^3) of H_2

B 4.0 grams of H_2

C 2.0×10^{23} molecules of H_2

D 4.0 kilograms of H_2

28 $2H_2S\ (g) + 3O_2\ (g) \rightarrow 2H_2O\ (g) + 2SO_2\ (g)$

If 3.50 g of H_2S are used in the reaction, what will be the theoretical yield of water in grams?

F 0.102 g

G 0.185 g

H 1.85 g

J 185 g

29 A sample of nitrogen gas is collected over water at 20°C. The vapor pressure of water at 20°C is 18 mmHg. What is the partial pressure of the nitrogen if the total pressure is 765 mmHg?

A 18 mmHg

B 747 mmHg

C 765 mmHg

D 783 mmHg

30 Ideal Gas Law constant $= 8.31 \frac{dm^3 \cdot kPa}{K \cdot mol}$

How many moles of CO_2 are there in a 50.0 dm^3 sample of the gas at a pressure of 100.0 kPa and a temperature of 50°C?

F 1.20 moles

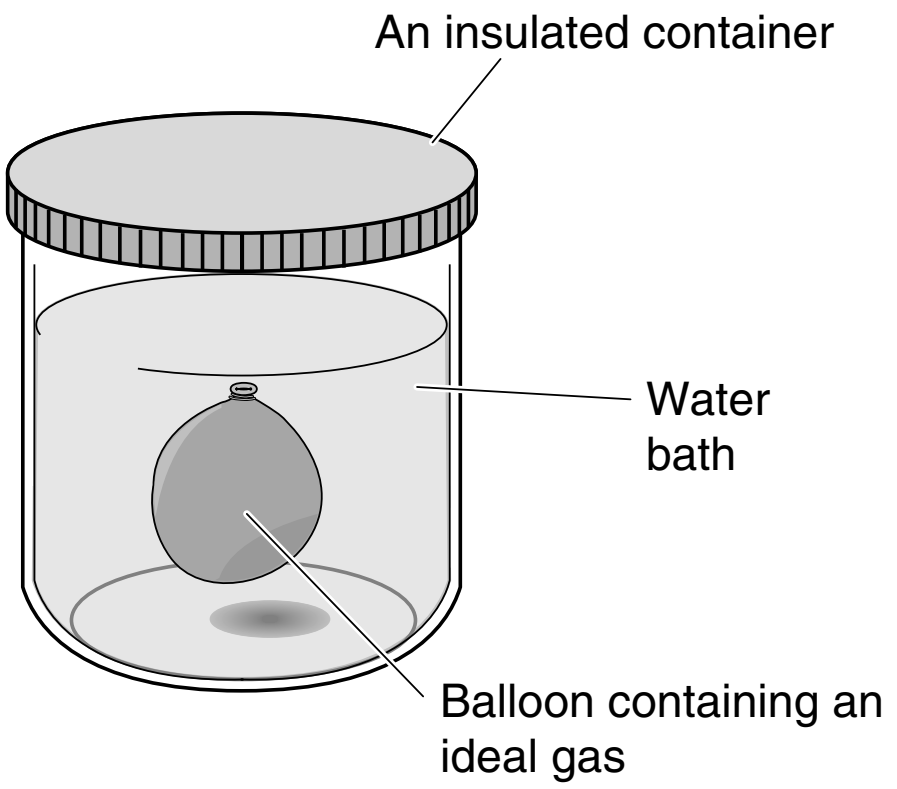
G 1.86 moles

H 2.0 moles

J 12.0 moles

GO ON

31



One way to increase the volume of the gas in the balloon in the diagram is to

A cool the gas in the balloon only

B increase the temperature of the water

C push the balloon farther down into the water bath

D seal the top of the water bath

GO ON

32 $2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$

How many liters of oxygen are required to produce 2 liters of water?

F 1

G 2

H 3

J 4

33 A solution which has a concentration that exceeds its predicted solubility at a certain temperature and pressure would be

A unsaturated

B saturated

C supersaturated

D dilute

GO ON

34 $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$

Ten moles of hydrogen and ten moles of iodine were put into a sealed 1-liter container at 490°C and allowed to react. After a while, there were still small amounts of unreacted hydrogen and iodine, but the hydrogen iodide concentration became constant. This is because

F there was not enough hydrogen to react with all of the iodine

G the hydrogen iodide was reacting with the container

H iodine loses its reactivity at high temperatures

J the reaction reached a state of equilibrium

35

The pH Ranges of Common Indicators

Indicator	pH range	Color it turns if pH below range	Color it turns if pH above range
cresol red	0.2 - 1.8	red	yellow
methyl orange	3.2 - 4.4	red	yellow
methyl red	4.8 - 6.0	red	yellow
litmus	5.5 - 8.0	red	blue
bromothymol blue	6.0 - 7.6	yellow	blue

A solution of unknown pH was tested with two indicators. Methyl orange turned yellow and methyl red turned red. Which of these could be the pH of the solution?

A 3.0

B 4.0

C 4.6

D 6.2

36

pH	1-6	7	8-14
Solution added	Acid	Neutral	Base
Litmus paper changes from	Blue to red	Does not change	Red to blue

Which of the following aqueous solutions will cause litmus paper to turn red?

F NaOH

G NaCl

H HCl

J H_2O

37 Which phase change involves the absorption of heat?

A Gas to liquid

B Liquid to solid

C Liquid to gas

D Gas to solid

38

Substance	Heat of Vaporization at the Boiling Point
Water (H_2O)	539 calories per gram
Alcohol (CH_3CH_2OH)	204 calories per gram
Chloroform ($CHCl_3$)	59 calories per gram

What probably causes chloroform to have the lowest heat of vaporization?

F Smallest size of the molecules listed

G Smallest mass of the molecules listed

H Smallest intermolecular forces of attraction

J Fewest number of bonds

GO ON

39 How many calories are required to raise the temperature of 105 g of water from 30.0°C to 70.0°C?

A 1.05×10^3

B 2.10×10^3

C 4.20×10^3

D 8.40×10^3

GO ON

40

	Molecular Weight	Density	Polar	Melting Point (˚C)	Boiling Point (˚C)
Benzene	78.11	.878	No	5.5	80
Methanol	32.04	.791	Yes	-97	65
Hexane	86.18	.659	No	-91	98
Octane	114.23	.702	No	-57	126
Water	18.0	1.0	Yes	0.0	100

A student needed to dissolve a substance that she knew was soluble in water. According to the chart, which other solvent would most likely dissolve the substance?

F Benzene

G Methanol

H Hexane

J Octane

STOP

Answer Key

Test Sequence Number	Correct Answer
1	C
2	J
3	A
4	G
5	B
6	F
7	D
8	G
9	C
10	J
11	D
12	H
13	D
14	G
15	A
16	J
17	D
18	J
19	C
20	H
21	B
22	H
23	C
24	F
25	A
26	J
27	B
28	H
29	B
30	G
31	B
32	F
33	C
34	J
35	C
36	H
37	C
38	H
39	C
40	G